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Lotka's Law and Pattern of Author Productivity of Information Literacy Research Output

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Abstract

Bibliometric analysis was carried out in the research output of information literacy using Web of Science (WOS) from 2008-2017. The objectives of the study is to identify the authorship pattern, measure and calculate the relative growth rate and doubling time of the research output and testing of the validity of Lotka's law using Kolmogorov-Smirnov test (K-S) goodness of fit test. The result shows that the applicability of Lotka's law was fit to the research output of information literacy.

Keywords: Lotka's law, Information literacy, Author productivity, Bibliometrics.

Introduction

In the year 1969 two Russian scientists Nalimor and Mulechenko was first coined the term scientometric. Scientometrics is a quantitative method which is now used for the application of the history of science and overlaps with bibliometrics to a considerable extent. It is the combination of two words sciento and metric, to measure the scientific productivity of literature output of the globe. This is a quantitative study and analysis the various aspects of literature output like country, year of publication, document type, authorship pattern, journals etc. According to A.F.J. Van Raan, scientometric research is define as quantitative studies of science and technology literature output. Wilson states that scientometric subtitles includes all quantitative aspect of the science, communication in science and science policy.

In this paper an attempt made to analyse the authorship pattern, testing the applicability of Lotka's law and study the relative growth rate and doubling time of literature published in the topic of information literacy during the year 2008-2017.

2.Information Literacy

Zurkowski (1974)[1] define that people trained in the application of information resources to their work can be called information literates. They have learned techniques and skills for utilizing the wide rage of information tools as well as primary sources in modelling information solution to their problems. The term information literacy first appeared in library literature during the 1970s. Information literacy is used to create awareness and demonstrate the people to know how they

gather, use, manage, synthesise and create information in an ethical manner, and they need skills to access their required information as early as possible in an allocated time period.

The information literacy frame work 2016 was adopted by the association of college and research. It states that information literacy is the set of integrated abilities encompassing the reflective discovery of information, the understanding of how information is organized, evaluate, and the use of information which is creating new knowledge and participating ethically in communities of learning. Information literacy is a set of abilities requiring individual's to recognize to locate, evaluate and use the essential information effectively.

Information is available in various forms like graphical, textual, signs, multimedia etc. It is stored as a resources in libraries, resources centers, organizations, media and internet. It is a life long learning process and common to all who have the need of information.

3.Review of Literature

Engin Arik (2015)[2]investigated a study on bibliometric analysis of linguistics publications in web of science between 1900 and 2013. It focus the number of publications in Social Science Citation Index (SSCI) and Arts and Humanities Citation Index (A&HCI) between 1975 and 2013. The results showed that SSCI ranked language linguistics category as no.62.51, no 35.3 as linguistics category and 21. 69 as linguistics research area whereas A&HCI ranked as language linguistics category as no 9.33, linguistics category as no 22.15 and linguistics research area as no 7.92. The number of publication increased well in both citation index. He concluded that linguistics is an important field in both social sciences and arts and humanities.

Devalingam, Ramesh Babu and Suresh (2015)[3] explained the global research output and growth rate study in the field of plastic technology in SCOPUS database for the period from 2010-2014. The result shows that 1950 articles published in the year of 2014. 4276 articles are published in journals. The growth rate is 0.73 in 2011 and decreased up to 0.24 in 2014. The doubling time of publications doubles once in two years.

Manthiramoorthi and Thamaraiselvi(2016)[4] has conducted a study on bibliometric analysis of national conference proceedings. The results indicated that 53 articles was published in various topics. Majority of the articles are in the topic of infrastructural ICT facilities library and information services to the special user group. Most of the articles are contributed by the librarian, and double authors.

Lotka's Law

The term bibliometric was coined almost 50 years before the statistical analysis of the scientific literature. In 1926 Alfred J. Lotka was tested the frequency distribution of scientific productivity from chemical abstracts (1907-1916)[5]. Lotka concluded that the number of authors making n contribution is about $1/n^2$ of those making one and the proportion of all contributors the

makes a single contribution is about 60 percent.

For this study Lotka's Inverse Power Law model was used to describing the pattern of authors scientific productivity in a specific subject over a fixed time period has been applied and its mathematical representation is

$$y = C \times x^{-n} \quad (1)$$

where x is the number of publications of interest (1,2, etc.,); n is an exponent that is constant for a given set of data; y is the expected percentage of authors with frequency x of publications; and C is a constant

The constant C is calculated using the following formula as

$$C = \frac{1}{\sum 1/x^n} \quad (2)$$

The exponent n is often fixed at 2, in which case the law is known as the inverse square law of scientific productivity. However, given that the exponent n predicts the relative number of authors at each productivity level it would seem useful to calculate it. In the present study, the least square method has been used. It can be expressed as follows:

$$n = \frac{N\sum XY - \sum X \sum Y}{N \sum X^2 - (\sum X)^2} \quad (3)$$

Where N is the number of data pairs considered; X is the logarithm of x (x=number of articles); and Y is the logarithm of y (y=number of authors)

Pao (1986)[6] suggests to applying the non-parametric Kolmolgorow – Smirnov (KS) goodness of fit test to verify whether the observed distribution of author productivity fit the estimated distribution of author productivity. The maximum difference between the observed and estimated distribution was calculated. The calculated value was compared with the critical value(c.v) and its formula is

$$c.v = \frac{1.63}{\left(\sum y_x + (\sum y_x / 10)^{1/2}\right)^{1/2}} \quad (4)$$

Objectives

1. To identify the year-wise distribution of the literature output.
2. To examine the authorship pattern of the literature output.
3. To find out the top five journal contributions of literature output.
4. To measure and calculate the relative growth rate and doubling time of publications using exponential growth model.
5. To examine the validity of Lotka's law of author's scientific productivity using Kolmogorov-Smirnov test (K-S) goodness of fit test.

Methodology

Data sources of the study are the literature research output of the topic information literacy was downloaded from Web of Science (WOS), during 2008-2017 for five-year period. The total of 2062 records was found. The data was analysed and interpreted using percentage and K-S statistical test.

Analysis and Interpretation

Table 1: Year wise distribution of Literature Output

Sl.No	Year	No. of Output	Percentage
1	2008	116	5.63
2	2009	120	5.82
3	2010	128	6.21
4	2011	163	7.90
5	2012	148	7.18
6	2013	148	7.18
7	2014	145	7.03
8	2015	326	15.81
9	2016	379	18.38
10	2017	389	18.87
Total		**2062**	**100.00**

Table 1 shows that year wise distribution of literature output. Out of 2062 articles 389 (18.87%) articles was published in the year 2017, followed by 379 (18.38%) articles was published in the year 2016, 326 (15.81%) articles was published in the year 2015 whereas in the year 2008 116 (5.63%) articles was published. Hence, it concluded that the highest number of articles was published in the recent three years and the lowest number of articles was published in the beginning year of the study.

Table 2: Authorship Pattern of Literature Output

Sl.No	Authorship pattern	No. of Output	Percentage
1	Single	860	41.71
2	Two	618	29.97

3	Three	342	16.58
4	More than three	242	11.74
Total		2062	100.00

Table 2 shows that authorship pattern of literature Output. Out of 2062 research output, 860 (41.71%) were contributed by single author followed by 618 (29.97%) were contributed by two authors, 342 (16.58%) were contributed by three authors and 242 (11.74%) were contributed by more than three authors. Hence, it concluded that highest number of literature output were contributed by single author.

Table 3: Top Five Journal Contributions of Literature Output

Sl.No	Journal	No. of Contribution	Percentage
1	Journal of Academic Librarianship	155	7.51
2	College & Research Libraries	72	3.49
3	Portal Libraries and the Academy	71	3.44
4	Reference Service Review	61	2.95
5	Information Research	61	2.95

Table 3 reveals the Top 5 journal contributions of literature output was tabulated for the study. 155 (7.51%) of articles was published in journal of academic librarianship followed by 72 (3.49%) articles was published in college and research libraries, 71 (3.44%) of articles was published in portal libraries and academy whereas 61 (2.95%) of articles was published in reference service review and information research journals.

Table 4: Relative growth rate and Doubling time of Literature Output

Year	No. of Publications	Percentage	Cumulative of Publications	W1	W2	R(a) W1-W2	Dt (a)	Mean Dt (a)
2008	116	5.63	116	-	4.75	-	-	10.6
2009	120	5.82	236	4.75	4.78	0.03	23.1	
2010	128	6.21	364	4.78	4.85	0.07	9.9	
2011	163	7.90	527	4.85	5.09	0.24	2.9	
2012	148	7.18	675	5.09	4.99	0.1	6.93	
2013	148	7.18	823	4.99	4.99	0	0	
2014	145	7.03	968	4.99	4.97	0.02	34.65	
2015	326	15.81	1294	4.97	5.78	0.81	0.85	
2016	379	18.38	1673	5.78	5.93	0.15	4.62	
2017	389	18.87	2062	5.93	5.96	0.03	23.1	

Table 4 shows the relative growth rate and doubling time of information literacy topic during the period of 2008-2017. It is clearly states that relative growth rate of the research output was increased and decreased versa vice. The highest relative growth rate was 0.81 in 2015. The doubling time range from 0.85 to 34.65. It indicates that information literacy research output get doubled with in 34 years. Average doubling time works out to 10.6 which represent that the literature in information literacy will be doubles once in ten years.

x	y	X	Y	X^2	XY	yx / ∑ y x	∑(y x / ∑y x	1/ x n	f = C(1/ x n)	∑	D
154	1	2.188	0.000	4.785	0.000	0.154	0.154	0.028	0.008	0.008	0.146
118	2	2.072	0.301	4.293	0.624	0.118	0.273	0.034	0.010	0.017	0.255
97	3	1.987	0.477	3.947	0.948	0.097	0.370	0.039	0.011	0.028	0.341
43	4	1.633	0.602	2.668	0.983	0.043	0.413	0.069	0.020	0.048	**0.365**
6	5	0.778	0.699	0.606	0.544	0.006	0.419	0.281	0.079	0.127	0.292
5	6	0.699	0.778	0.489	0.544	0.005	0.424	0.319	0.090	0.217	0.207
5	7	0.699	0.845	0.489	0.591	0.005	0.429	0.319	0.090	0.307	0.122
1	8	0.000	0.903	0.000	0.000	0.001	0.430	1.000	0.282	0.589	-0.159
3	9	0.477	0.954	0.228	0.455	0.003	0.433	0.459	0.129	0.718	-0.285
1	15	0.000	1.176	0.000	0.000	0.001	0.434	1.000	0.282	1.000	-0.566
433		**10.533**	**6.736**	**17.504**	**4.689**	**0.434**	**3.778**	**3.549**	**4.549**		

Table 5: Literature Research Output of Author Productivity Based on Lotka's Law

x = Number of Contribution y = Number of Authors **c=0.282; n=0.706; c.v. = 0.409; D = 0.365**

Table 5 shows that the author productivity based on Lotka's law on literature research

output. In order to examine validate Lotka's law, a calculation was made using the equation (1-3) to know the values of n and c to test whether the Lotka's law concept was fits to the data of the present study are not. Based on the above table the value of n=0.706 and c=0.282 respectively. Using the equation (4) the critical value (c.v) is 0.409 and the value of maximum difference (D) is 0.365. Therefore, it is clear that D value is less than that of critical value which resulted as the data was fits to the Lotka's law.

7.Findings & Conclusion

This study investigated the outputs of information literacy research publications. The results showed that the highest number of publications was published in the year 2017. The majority of the research outputs was published as articles and book review. The highest language wise contribution was English. USA contributed more number of publications in the topic of information literacy. Single author was contributed more number of articles in the relevant topic and the journal of academic librarianship was published the highest number of publications. It is clearly states that relative growth rate of the publications output was increased and decreased versa vice. The highest relative growth rate was 0.81 in 2015. The doubling time range from 0.85 to 34.65. It indicates that information literacy publications get doubled with in 34 years. Average doubling time works out to 10.6 which represent that the publications in information literacy will be doubles once in ten years. According to the applicability of Lotka's law stated that the D value (0.365) is less than that of critical value (0.409) which resulted as the data was fits to the Lotka's law.

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